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MPSG ANNUAL EXTENSION REPORT

PROJECT TITLE: **Development of an integrated weed management (IWM) package to mitigate and manage glyphosate-resistant weeds in soybean**

PROJECT START DATE: 1 April 2019 **PROJECT END DATE: 31 March 2024**

DATE SUBMITTED: 15 January 2020

PART 1: PRINCIPAL RESEARCHER

PRINCIPAL INVESTIGATOR		**CO-PRINCIPAL INVESTIGATOR**	
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PART 2: EXECUTIVE SUMMARY

Outline the project objectives, their relevancy to pulse and soybean farmers, and a summary of the project to date, including methods and preliminary results.

This project aims to provide soybean growers with the tools required to reduce the selection pressure for glyphosate-resistant weeds in soybean cropping systems, and to facilitate the sustainable production of soybean in western Canada. Four separate field experiments will be conducted in the growing seasons of 2019, 2020, and 2021 at various locations in Manitoba, Saskatchewan, and Alberta.

All of the experiments will focus on the performance of soybean in weedy and weed-free conditions. This will aid in our understanding of how weeds impact soybean yield loss and how soybean agronomy may be optimized to mitigate yield loss and also reduce weed seed production. One experiment will assess the impacts of crop sequencing, residue management, and soybean planting date. Another will assess soybean growth habit, maturity grouping and planting date. A third experiment will assess the impacts of fall rye cover cropping, soybean growth habit, row spacing, and seeding rate, while a fourth experiment will determine the optimal soybean row spacing and seeding rate based on soybean growth habit (bushy vs. erect).

In the first growing season (2019), an experiment assessing the impacts of soybean growth habit, maturity grouping and planting date on soybean productivity and weed competition was completed at three sites: Portage MB, Saskatoon SK, and Lethbridge AB. This experiment will be repeated in 2020. Preliminary results from the Lethbridge location indicate that soybean yield increased as the maturity grouping of soybean increased. This result was similar in both weedy and weed-free conditions, even though weed competition resulted in soybean yield decline (about 40 to 60% yield loss). Differences in soybean biomass were not significant, likely due to the lack of statistical power from including only one site-year in the analysis. More site-years will be required to assess these impacts properly.

PART 3: PROJECT ACTIVITIES AND PRELIMINARY RESULTS

Outline project activities, preliminary results, any deviations from the original project and communication activities. You may include graphs/tables/pictures in the Appendix.

In 2019, experiment 2 was completed at three sites, one at each of Portage MB (MacMillan), Saskatoon SK (Willenborg), and Lethbridge AB (Geddes). This experiment will determine the impacts of soybean growth habit, maturity grouping, and planting date on soybean productivity under weedy and weed-free conditions, in addition to impacts on weed competition. The three sites of experiment 2 were completed as planned with no deviations from the protocol. Seven soybean cultivars were chosen based on plant architecture (covering a range from bushy to erect plants and lanceolate leaf to round leaf structure). The cultivars spanned a range of reported maturity groupings from 000.5 (2175 CHU) to 00.7 (2475 CHU). Cultivar identity will be protected pending approval from the seed companies, according to the material transfer agreements. Early, mid and late planting dates at Lethbridge were May 14, May 24 and June 04, at Saskatoon were May 14, May 23, and June 03, and at Portage were May 21, May 29, and June 12. All data were collected and plots were harvested as planned. The main measurements were as follows:

- days to emergence and to maturity
- soybean and weed density by species @ V1 and R5
- soybean % canopy closure @ VC, V1 & V3 (of early planting date), and biweekly thereafter
- images captured for post-hoc leaf area assessment @ VC, V1 & V3 (of early planting date), and biweekly thereafter
- soybean and weed biomass @ V3 (early planting date only) and R5
- soybean height @ V3, R5 and R8
- soybean branch number @ R5
- number of nodules per plant @ R5 (Lethbridge only)
- nodule biomass per plant @ R5 (Lethbridge only)
- weed seed retention
- weed seed shatter
- weed seed in dockage
- % dockage
- soybean yield, adjusted to 13.5% moisture

Preliminary data analyses for the Lethbridge site of experiment 2 showed that soybean yield increased as soybean maturity grouping increased [increasing from cultivar 1 (earliest maturity group) to 7 (latest maturity group)] (Figure 1). This result was consistent in both the presence and absence of weed competition, indicating that the highest yielding soybean cultivars under weed-free conditions maintained the highest yield under weed competition. This is good news for soybean growers because it suggests that high yielding soybean cultivars perform well in both the presence or absence of weeds. The top three weed species at Portage were lamb's quarters, green foxtail, and redroot pigweed, at Saskatoon were green foxtail, lamb's quarters, and kochia, and at Lethbridge were green foxtail, volunteer wheat, and goat's beard. At Lethbridge in 2019, differences in weed biomass were absent at soybean stage R5 ($P = 0.253$), likely due to potential spatial variability in ambient weed communities or low statistical power when using a single site-year of data in the analysis. More site-years of data will be required to interpret these results appropriately.

In 2019, all preceding crops for experiment 3 were seeded and harvested at Portage MB (MacMillan), and Lethbridge AB (Geddes). All tillage treatments were conducted in fall 2019, with the exception of the corn plots at Portage where late harvest precluded the tillage treatments (these will be completed in spring 2020). The fall rye cover crop treatments in experiment 4 were seeded in fall 2019 at Carman MB (Gulden), Indian Head SK (Holzapfel), Brooks AB (Bandara), and Lethbridge AB (Geddes) in preparation for planting soybean in 2020.

In short, all research was completed as proposed and we have no deviations from the protocol to report.

APPENDIX

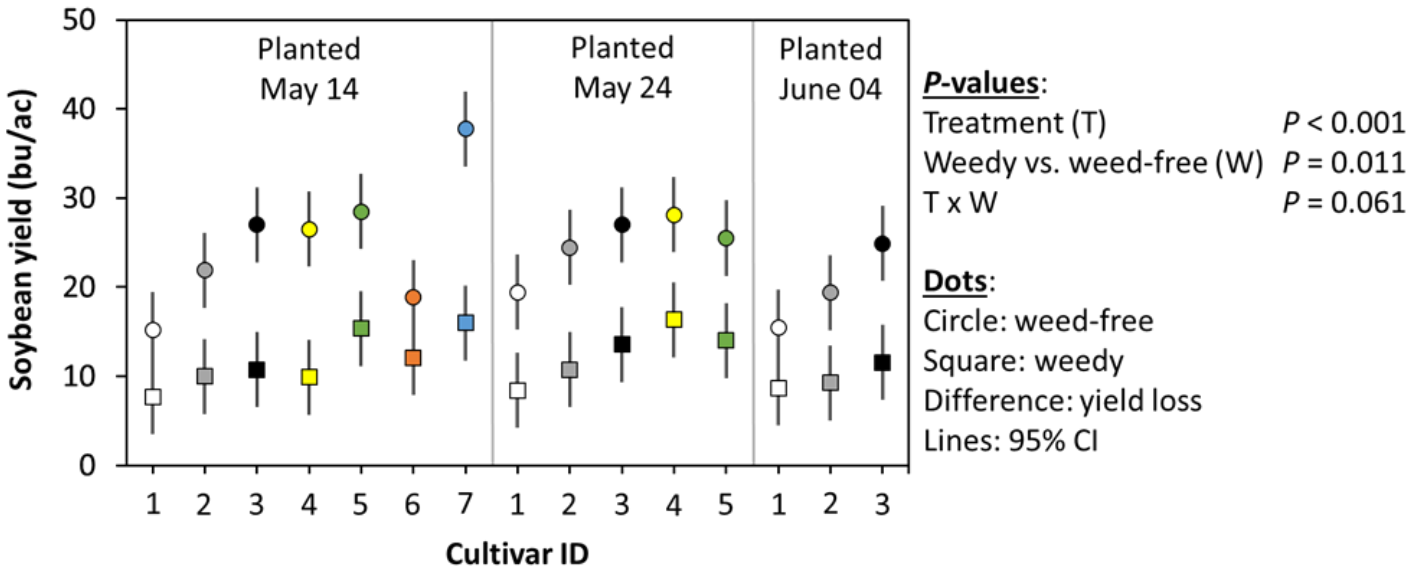

Figure 1. Soybean yield in response to cultivar choice (cultivar ID) and planting date (May 14 vs. May 24 vs. June 04) in the presence and absence of weeds at Lethbridge, Alberta, 2019. Dots indicate means, while lines indicate 95% confidence intervals. Overlap of 95% confidence intervals indicates lack of significant difference (α = 0.05).

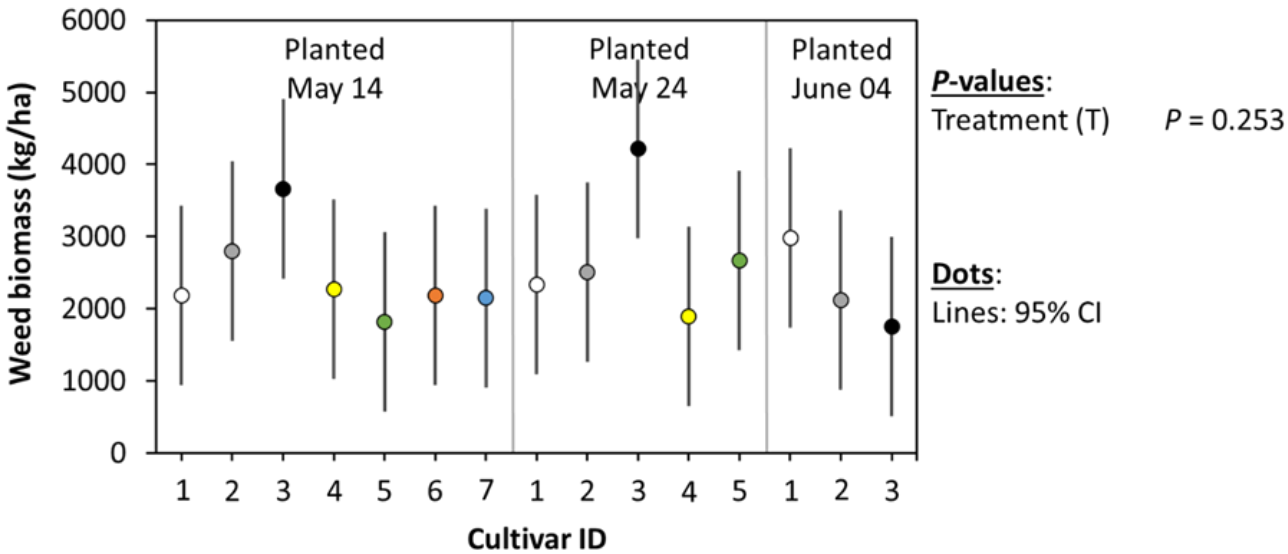

Figure 2. Weed aboveground biomass (collected at soybean stage R5) in response to soybean cultivar (cultivar ID) and planting date (May 15 vs. May 24 vs. June 04) at Lethbridge, Alberta, 2019. Dots indicate means, while lines indicate 95% confidence intervals. Overlap of 95% confidence intervals indicates lack of significant difference (α = 0.05).